TOTAL MAXIMUM DAILY LOADS
UPPER ANACOSTIA RIVER
LOWER ANACOSTIA RIVER
DISTRICT OF COLUMBIA

BIOCHEMICAL OXYGEN DEMAND

DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH ADMINISTRATION
BUREAU OF ENVIRONMENTAL QUALITY
WATER QUALITY DIVISION
WATER QUALITY CONTROL BRANCH

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INTRODUCTION

Section 303(d)(1)(A) of the Federal Clean Water Act (CWA) states:

> Each state shall identify those waters within its boundaries for which the effluent limitations required by section 301(b)(1)(A) and section 301(b)(1)(B) are not stringent enough to implement any water quality standards applicable to such waters. The State shall establish a priority ranking for such waters taking into account the severity of the pollution and the uses to be made of such waters.

Further section 303(d)(1)(C) states:

> Each state shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculations. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

In 1996, the District of Columbia (DC), developed a list of waters that do not or are not expected to meet water quality standards as required by section 303(d)(1)(A). The list was revised in 1998. The list of water bodies contains a priority list of those waters which are the most polluted. This priority listing is used to determine which of those water bodies are in critical need of immediate attention. This list, submitted to the Environmental Protection Agency every two years, is known as the Section 303(d) list. For each of the listed waters, states are required to develop a Total Maximum Daily Load (TMDL) which calculates the maximum amount of a pollutant that can enter the water without violating water quality standards and allocates that load to all significant sources. Pollutants above the allocated loads must be eliminated.

The District of Columbia's section 303(d) list divides the Anacostia into two segments. The lower Anacostia is identified as that portion of the river extending from the mouth of the river to the John Philip Sousa Bridge at Pennsylvania Avenue and the upper Anacostia from the bridge to the Maryland border.

APPLICABLE WATER QUALITY STANDARDS

The Anacostia River is listed on DC's 1996 and 1998 303(d) lists because of violations of the Dissolved Oxygen (DO) water quality standard for the District of Columbia. Title 21 of the District of Columbia Municipal Regulations (DCMR) Chapter 11 contains the Water Quality Standards (WQS). The Anacostia River has the designated beneficial uses of:

1. Class A- primary contact recreation,
2. Class B- secondary contact recreation,
3. Class C- protection and propagation of fish, shellfish, and wildlife,
4. Class D - protection of human health related to consumption of fish and shellfish, and;
5. Class E- navigation.

Class C waters must achieve or exceed water quality standard for dissolved oxygen. The WQS for DO are 5.0 milligrams per liter (mg/l) as a daily average and must achieve or exceed a one hour value of 5.0 mg/l for the fish spawning period of March through June and 4.0 mg/l for the remainder of the year. Dissolved oxygen values lower than 4.0 or 5.0 mg/l impair fish growth and reproduction, particularly in the younger fish. Values less than 2.0 mg/l may cause fish mortality. Figure 1 demonstrates the relationship between rainfall induced pollution loads on dissolved oxygen and fish. Data from a continuous dissolved oxygen monitoring device is plotted relative to rainfall. A rainfall event of about one-inch in late May, 1999 causes the dissolved oxygen to drop into the potential fish kill range. Then remain in violation of the water quality standards until the June 12 rainfall event of 1.3 inches which dropped the dissolved oxygen to near zero and results in killing of about 5,000-7,000 fish in the Anacostia River. This particular event is typical of wet weather induced problems in the Anacostia River.

For the most part, DO depends on the quantity of Biochemical Oxygen Demand (BOD) in the water body, but other substances such as ammonia, Total Kjeldahl Nitrogen (TKN) and algae also affect the DO. This TMDL addresses the impairment of the Class C use because of low dissolved oxygen due to excessive BOD. The TMDL provides numeric target reductions that compliment DC's ongoing efforts to protect the Anacostia River and will guide future efforts.

BACKGROUND

Around 1800, the Anacostia River was a major thoroughfare for trade in the area now known as the District of Columbia, particularly for Bladensburg, a deep water port in Maryland. By 1850, however, the Anacostia River had developed sedimentation problems due to deforestation and improper farming techniques related to tobacco farms and settlements. Channel volumes were greatly decreased and stream flow patterns were altered. Due to the continuation of the urbanization process, the river was never able to flush out the excessive amount of sediment and nutrients.

The District of Columbia, as many cities in the 19th and early 20th centuries, developed a combined sewer system, which transported both rainfall and sanitary sewage away from the developed areas and discharged it into the rivers. The two major combined sewage outfalls were at the present location of the "O" Street Pump Station and at the Northeast Boundary Sewer just below Kingman Lake. In the 1930s, Blue Plains Wastewater Treatment Plant (WWTP) was constructed and dry weather sewage flows were transported across the Anacostia River to Blue Plains. However, the wet weather flows were and are often greater than the transmission capacity of the pump stations and piping system and resulted in overflows. Later, sewer system construction techniques utilized two pipes so that the storm water could be kept separate from the sanitary sewage. Storm water is transported to the nearest stream channel and discharged while the sanitary sewage is transported to Blue Plains WWTP for treatment.

CURRENT LAND USE

The Anacostia watershed is approximately 117,353 acres with the drainage area being 49% in Prince George's County, 34% in Montgomery, and 17% in the District of Columbia. Two thirds of the basin lies within the Coastal Plain and the remaining is in the Piedmont. The range in elevation in the catchment area is very slight according to the USGS topographic quadrangle maps. The head of tide for the Anacostia River is at Bladensburg, MD.

The non-tidal portion of the Anacostia River is composed of the two branches, the Northeast Branch and the Northwest Branch. Their confluence is at Bladensburg, MD. For all practical purposes the tidal portion of the Anacostia River can be considered to begin at their confluence, although the Northeast and Northwest Branches are tidally-influenced up to the location of the USGS gages on each branch: Station 01649500 at Riverdale Road on the Northeast Branch and Station 01651000 at Queens Chapel Road on the Northwest Branch.

Land use in the Anacostia River watershed is mostly residential and forested. There are 30% park and forest lands evenly dispersed throughout the watershed, such as the National Park Service, the National Arboretum, Greenbelt Park, and Beltsville Agricultural Research Center. The industrial and manufacturing land use is largely confined to the tidal area of the basin such as Hickey Run, Lower Beaverdam Creek, and Indian Creek. These sub-watersheds contain impervious areas as high as 80%. (See Figure 2.) A more detailed description of the water body is available in "An Existing Source Assessment of Pollutants to the Anacostia Watershed" (Metropolitan Council of Governments, 1996).

STREAM FLOW

The mean annual stream flow for the Northwest Branch is 48.6 cubic feet per second and the mean annual flow for the Northeast Branch is 86.4 cubic feet per second. These tributaries provide a combined mean annual flow of 135 cubic feet per second. The WQS specify that the dissolved oxygen standards must be met at the lowest seven day consecutive average that has a recurrence interval of once in ten years, known as the 7Q10. The 7Q10 for the Northeast Branch is 5.9 cubic feet per second and the 7Q10 for the Northwest Branch is 1.8 cubic feet per second. Average annual flows in cubic feet per second (cfs) for the years used in this TMDL are as follows:

	Northeast	Northwest	Combined
1988	72.5	43.9	116.4
1989	111.3	67.0	178.3
1990	93.2	60.4	153.6

The year 1988 is 35% below average flow and the year 1989 is 30% above average flow.

WATER QUALITY STANDARDS AND TARGET VALUES

The Anacostia River has several designated uses as detailed in DC's Water Quality Standards (WQS) (Appendix 1). Class C waters have an associated daily average minimum numeric criteria for DO of 5.0 mg/L. When BOD increases in the water body, DO concentrations decrease. Excessive algal growth caused by over enrichment with nitrogen and/or phosphorus contribute to dissolved oxygen violations through the daily photosynthesis cycle and through the decay of dead algal cells. The purpose of this TMDL is to determine the limit to which BOD must be reduced and to achieve and maintain the Water Quality Standards for DO.

Figure 3 presents data collected for the summer of 2000 from the continuous DO monitor at the New York Avenue Bridge which is the border between Maryland and D.C. This data shows that the quality of the water entering DC does not meet DC's water quality standards.

SOURCE ASSESSMENT

Within the District of Columbia, there are three different networks for conveying waste water. Originally, a combined sewer system was installed which collected sanitary waste and storm water and transported the sanitary flow to the waste water treatment plant. When storm water caused the combined flow to exceed the pipe capacity leading to the treatment plant, the excess flow was discharged, untreated, through the combined sewer overflow to the river. There are 17 combined sewer overflows to the Anacostia River.

In the upper two thirds of the drainage area, a separate sanitary sewer system and a storm sewer system were constructed. A separate sanitary sewer line has no storm water inlets to the system and it flows directly to the waste water treatment facility. Storm water pipes collect storm water from the streets and parking lots and are discharged to the rivers.

Point Sources

Figure 4 is a map of the Combined Sewer Overflows on the Anacostia River. The CSO outfalls are located only in the lower part of the Anacostia River. According to DC Water and Sewer Authority (WASA), there is approximately 1.5 billion gallons per year total CSO flow to the Anacostia (Public Meeting for the Long Term Control Plan). This amount is equivalent to approximately 4.1 million gallons per day. U.S. EPA has issued a storm water permit to DC that regulates storm sewer discharges as point sources.

Nonpoint Sources

For the purposes of this TMDL, storm sewer flow is considered part of the non-point source load. Some of these storm sewers are actually small streams that have been either partially or totally piped. The computer model, BASINS, does not differentiate significantly from a small tributary and a large storm sewer. Storm sewer loads to tributaries, such as Watts Branch, are not independently calculated by BASINS.

Upstream (Maryland) Sources

Storm water runoff from the large drainage area in Maryland contributes significantly to the dissolved oxygen problem in the both Maryland’s tidal portions and DC’s portion of the Anacostia River. Loads for the Maryland portion of the basin are calculated using data primarily for the years 1988-1990. All of the Lower Beaver Dam Creek loads and 53% of the Watts Branch loads are assigned to Maryland.

Total Loads

DO concentrations are affected by all of the previously mentioned sources. The average annual loads for the three year period 1988, 1989, and 1990, in pounds, are calculated below for Maryland, CSO, and DC storm water (DCSW):

Upper Anacostia Existing Loads 4- 8				
Model segments	Source	BOD	TN	TP
4	SW	2102821	842837	119431
5	SW	38542	9393	1652
6	SW	4638	1169	207
6	SW	73463	23270	2958
7	SW	23952	4831	745
8	SW	40320	9487	1660
	Subtotal	2283736	890987	126652
Lower Anacostia Existing Loads 9-14				
9	SW	24344	6342	1125
9	CSO	807530	49081	28666
10	SW	22306	4499	731
10	CSO	3148	191	112
11	CSO	116486	7080	4135
11	SW	3695	727	112
12	CSO	75558	4592	2682
12	SW	24291	4899	796
13	CSO	571410	34730	20284
13	SW	20313	4097	632
14	SW	12013	2423	374
Subtotal		1681094	118660	59647
MD		2102821	842837	119431
CSO		1574133	95675	55878
DCSW		287876	71135	10990
Total		3964830	1009647	186299

TOTAL MAXIMUM DAILY LOADS AND ALLOCATION

Overview

This section describes how the BOD TMDL and total loading allocations for point sources and nonpoint sources were developed for the Anacostia River. The first section describes the modeling framework for simulating BOD loads, hydrology, and water quality responses. The second and third sections summarize the scenarios that were explored using the model. The assessment investigates water quality responses assuming different loading conditions. The fourth and fifth sections present the modeling results in terms of a TMDL, and allocate the TMDL between point sources and nonpoint sources. The sixth section explains the rationale for the margin of safety and a remaining future allocation. Finally, the pieces of the equation are combined in a summary accounting of the TMDL for annual loads.

Analysis Framework

The computational framework has four components, which include the Tidal Anacostia Model (TAM), Water Quality Simulation Program (WASP), Water Transport, and the Sediment Diagenesis Model. The inputs for TAM include tidal heights, upstream loads, and tributary subwatershed flows. TAM will create flows and loads, which will then serve as inputs for the WASP. This water quality simulation program provides a generalized framework for modeling water quality and transport in surface waters and is based on the finite-segment approach (Di Toro *et al.*, 1983). WASP5 is supported and distributed by U.S. EPA's Center for Exposure Assessment Modeling (CEAM) in Athens, GA (Ambrose *et al.*, 1988).

The Sediment Diagenesis model is the second generation WASP model which has been incorporated into TAM/WASP. This model was modified by Dr. Winston Lung of the University of Virginia from an earlier version done by Dr. Di Toro. It takes into account the BOD and nutrients moving between the sediment and the water column. More precisely, the sediment layers allow an interaction between the sediment oxygen demand and the water column. This model also describes changes in aqueous methane, gaseous methane, ammonia, and gaseous nitrogen. This is accomplished by keeping a mass balance of Carbonaceous Biochemical Oxygen Demand (CBOD) and Organic Nitrogen (ON).

The Anacostia TAM/WASP model divides the river into 15 segments from Bladensburg to its confluence with Potomac River shown in Figure 5. The upstream load from Maryland was calculated from land use and data that was provided by the Montgomery and Prince George's County storm water monitoring programs. The Combined Sewer Overflows, which start in segment 9 and go through 14, are also entered into the model. Segment 15 is the boundary between the Anacostia and the Potomac Rivers. TAM/WASP also incorporated storm sewer loads in all segments and tributaries such as Watts Branch and Lower Beaverdam Creek. Segments 1, 2, and 3 are located in Maryland and Segments 4-15 are in DC. Lower Beaverdam Creek, which enters segment 4, is predominantly in Maryland and all loads were counted as Maryland Loads. Watts Branch enters segment 6 and 53% of its loads originate in Maryland and 47% percent of the loads originate in DC.

The model was calibrated to meteorological, flow, and water quality data for the calendar years 1988, 1989, and 1990. This series of years is a reasonable set of conditions to examine load reduction scenarios because 1988 was a low flow year, followed by 1989 a high flow year, and 1990 an "average" flow year. There are no continuous permitted point source loads that contribute to the dissolved oxygen problem. The problem is due to a precipitation induced pollution load. The sequence of multiple storms along with the magnitude and timing of individual storms is more of a determining factor than stream flow.

Storm sewers and nonpoint source loads were computed using a BASINS (Better Assessment Science Integrating Point and Non Point Sources) model of Watts Branch. BASINS uses the watershed model, Hydrodynamic Simulation Program - FORTRAN (HSPF) with a Geographical Information Systems interface to calculate loads. These values were then used in a ratio between land use and basin size to calculate the loads for all of the other basins contributing to the river.

Scenarios

This model is based on seven constituents which are ammonia, NO_3, PO_4, Chlorophyll "a", BOD, DO, organic nitrogen, and organic phosphorous. In the scenario runs, these constituents are decreased at different locations and sources to ascertain which reductions meet water quality standards.

Scenario 1: Calibration
Following calibration of the TAM/WASP model by Interstate Commission on the Potomac River Basin (ICPRB), the U.S. Army Corps of Engineers' bathymetric surveys performed for the Kingman Lake wetlands became available. It was determined that the channel volumes had decreased significantly from those used in the model. WASA's consultant, Limno Tech Inc. developed a new segment geometry for the model and transferred the information to DOH. WASA had completed CSO monitoring for the long term control plans and there were indications that the CSO loads used to calibrate the model were too low. CSO loads were adjusted to about 1.5 billion gallons per year. The model was then re-calibrated by DOH with the new geometry and loads.

To set the TMDL, a series of scenarios were run to determine the amount of reduction of upstream loads in Maryland that would be needed to meet water quality standards at the DC line. These scenarios also provide enough assimilative capacity to accommodate some level of loads from DC's storm water and CSOs. District loads were set at low levels in order to isolate the effects of Maryland loads.

Scenario 2: Upstream Reductions
Storm water loads from Maryland were reduced by 40% for BOD and by 40% for nitrogen and phosphorus. DC loads from storm water and CSO were reduced by 90% for BOD and nutrients. D.O. standards were not met at the MD/DC boundary.

Scenario 3: Upstream Reductions
Storm water loads from Maryland were reduced by 50 % for BOD and by 40% for nitrogen and phosphorus. DC loads from storm water and CSO were reduced by 90% for BOD and nutrients. D.O. standards were usually met at the DC/MD boundary.

Scenario 4: Upstream Reductions
Storm water loads from Maryland were reduced by 60 % for BOD and by 40% for nitrogen and phosphorus. District loads from storm water and CSO were reduced by 90% for BOD and nutrients. D.O. standards were usually met at the DC/MD boundary.

Based upon a review of scenarios 2-4, it was estimated that if the Maryland portion of the basin achieved the Chesapeake Bay Agreement goals for nutrient reductions that the results would be about a 50% reduction in BOD and a 30% reduction in nitrogen and phosphorus. Scenarios 5, 6 and 7 were run to determine the relative importance of nitrogen versus phosphorus in reducing algal growth and the effects on dissolved oxygen.

Scenario 5: Upstream Nutrient Reductions

Storm water loads from Maryland were reduced by 50% for BOD and by 30% for nitrogen and phosphorus. DC loads from storm water and CSO were reduced by 90% for BOD and nutrients. D.O. standards were usually met at the DC/ MD boundary

Scenario 6: Upstream Nutrient Reductions
Storm water loads from Maryland were reduced by 50% for BOD and by 30% for nitrogen only. DC loads from storm water and CSO were reduced by 90% for BOD and nutrients. There was no substantial change from scenario 5.

Scenario 7: Upstream Nutrient Reductions
Storm water loads from Maryland were reduced by 50% for BOD and by 30% for phosphorus only. DC loads from storm water and CSO were reduced by 90% for BOD and nutrients. D.O. standards were met less frequently than for scenarios 5 and 6.

Reduction of phosphorus did not improve dissolved oxygen significantly. Reduction of nitrogen provided a small improvement at times by limiting algal growth in the upper parts of the tidal waters. The most of the time, algal growth was limited by the amount of light in the water column due to the suspended solids present. The Chesapeake Bay signatories including Mayor Williams and Governor Glendening have agreed to reduce the loads of suspended solids entering tidal waters. Once this reduction is established, it may become more important to reduce nutrients in the Anacostia. Any urban Best Management Practices (BMPs) that reduce BOD will reduce both phosphorus and nitrogen. A set of scenarios was run to determine the load reductions from CSOs. These were run using a reduction in DC generated storm water equivalent to that used for Maryland storm water.

Scenario 8: CSO Reductions
Storm water loads from Maryland were reduced by 50% for BOD and by 30% for phosphorus and nitrogen. DC loads from storm water were reduced by 50% for BOD and 30% for nitrogen and phosphorus. CSO were reduced by 73% for BOD and nutrients.

Scenario 9: CSO Reductions
Storm water loads from Maryland were reduced by 50% for BOD and by 30% for phosphorus and nitrogen. DC loads from storm water were reduced by 50% for BOD and 30% for nitrogen and phosphorus. CSO were reduced by 80% for BOD and nutrients.

Scenario 10: CSO Reductions
Storm water loads from Maryland were reduced by 50% for BOD and by 30% for phosphorus and nitrogen. DC loads from storm water were reduced by 50% for BOD and 30% for nitrogen and phosphorus. CSO were reduced by 87% for BOD and nutrients.

Scenario 11: CSO Reductions
Storm water loads from Maryland were reduced by 50% for BOD and by 30% for phosphorus and nitrogen. DC loads from storm water were reduced by 50% for BOD and 30% for nitrogen and phosphorus. CSO were reduced by 90% for BOD and nutrient. D.O. standards were met except for three storms

Scenario 12: CSO Reductions

Storm water loads from Maryland were reduced by 50% for BOD and by 30% for phosphorus and nitrogen. DC loads from storm water reduced by 50% for BOD and 30% for nitrogen and phosphorus. CSO were reduced by 94% for BOD and nutrients. D.O. were met except for three storms.

Scenario 13: Meet WQS
Storm water loads from Maryland were reduced by 70% to meet WQS at the Maryland/DC boundary. CSO loads were reduced by 90%. Storm water loads were reduced by 50% BOD and nutrients by 30%. Water quality standards were met at all times

Figures 6a – 6d show the improvement in dissolved oxygen resulting from an 90% reduction in CSO loads assuming that upstream and DC storm water are held constant at a 50% reduction of BOD and a 30% reduction of nutrients.

CRITICAL CONDITIONS AND SEASONAL VARIATIONS

Establishing the link between pollutant loads and in stream concentrations requires defining the conditions under which the loads reach the receiving water. TMDLs, according to Federal regulations, are to be developed for critical conditions—those conditions during which water quality standards are most likely to be violated. This is a formidable challenge in this case. The worst case scenario occurs when there is a large rainfall event which carries the CSOs and storm sewers into the river. The DO decreases after the storm when the BOD has quickly used up the oxygen. The increase in flow scours the river sediments and re-suspends the BOD that was stored in the sediments. Large storms also bring large upstream loads. Different rainfall patterns create different combinations of loads from the three sources, yet may show the same magnitude of dissolved oxygen decrease. A large thunderstorm in DC may not affect river flow significantly but have the same effect on dissolved oxygen as a longer more widespread rainfall in the upstream part of the basin, which will greatly increase stream flow. This is different than most rivers with a continuous point source discharge during dry weather where the worst case is having too little water to create turbulence and introduce oxygen. Inspection of the three major dissolved oxygen sags during the summer of 1990 shows that they occurred from different combinations of the three sources. The bottom sediment in the tidal river accumulates particulate BOD throughout the year. The decomposition process is temperature driven and is very slow at cold temperatures which causes significant amounts of the deposited winter loads to be available in the spring time and contribute to the summer time dissolved oxygen problem. Thus, there is a memory in the sediment of BOD loads from two to three years in the past. There does not appear to be a reason to establish seasonal loads.

ALLOCATIONS, REDUCTIONS, MARGIN OF SAFETY, AND THE TMDL

The total allowable load of BOD reflects the decreased amount of BOD to allow DO to remain over 5.0 mg/L as stated in the WQS criteria. The TMDL was then allocated between the waste load allocation (WLA) for the point source contribution, the load allocation (LA) for the nonpoint sources, and an explicit margin of safety (MOS) to further account for uncertainties in the analysis. The Anacostia is designated a zero discharge zone which prohibits discharge from boats.

Reducing Maryland and DC storm water BOD loads by 50% and nutrient loads by 30% and the CSO loads by 90% will achieve the WQS during a low flow and average flow years. Installing storm water BMPs that have high removal efficiencies at high flows will cause WQS to be met in high flow years. Meeting the WQS under these varied conditions provides a reasonable margin of safety.

For Maryland, a target annual load to be achieved is: 1,058,000 pounds of BOD, 84,583 pounds of phosphorus, and 593,039 pounds of nitrogen.

For District of Columbia sources, the following allowable BOD loads are allocated. The nitrogen and phosphorus loads are targeted:

Upper Anacostia TMDL includes the load and waste allocations from segments 4-8

Segment	**Source**	**BOD**	**Nitrogen**	**Phosphorus**
4	SW	12,844	5,591	1,086
5	SW	19,271	6,564	1,156
6	SW	19,583	8,464	1,116
7	SW	11,976	3,376	520
8	SW	20,160	6,631	1,160
Subtotal		83,834	30,626	5,038

Lower Anacostia TMDL includes loads from segment 9-15.

9	SW	12,172	4,432	788
9	CSO	80,753	7,362	4,300
10	SW	11,153	3,146	510
10	CSO	315	29	17
11	SW	1,848	508	79
11	CSO	11,649	1,062	620
12	SW	12,145	3,425	557
12	CSO	7,556	689	402
13	SW	10,156	2,864	440
13	CSO	57,141	5,209	3,043
14	SW	6,007	1,694	441
Subtotal		210,895	30,420	11,197
TOTAL	**SW**	**137,315**	**46,695**	**7,853**
TOTAL	**CSO**	**157,414**	**14,351**	**8,382**
TOTAL	**DC**	**294,729**	**61,046**	**16,235**

Load Allocation

Combined sewer overflows are point sources and are assigned a load allocation of 157,141 pounds per year of BOD, which is estimated to be a 90% reduction. Storm water discharges from storm sewers are point source discharges and are assigned a 50% reduction of BOD loads. There will be 0 discharge allocated for boats.

Waste load Allocation

Those storm water discharges, which are nonpoint sources are assigned a 50% reduction of BOD loads. The total allocation for point source and nonpoint source storm water is 137,315 pounds per year.

Storm Water Sub-Allocation

The non-CSO area in DC that generates storm water loads to the Anacostia is about 14,830 acres of which the National Park Service owns about 1,843 acres, the National Arboretum owns about 434 acres, and the southeast Federal Center and Washington Navy Yard combined about are 147 acres. Anacostia Naval Station drains about 227 acres to the Anacostia River and there is about 50 acres of miscellaneous facilities. Consequently, about 18% of the land generating storm water loads to the Anacostia River are federally owned. Each federal facility is allocated a 50% reduction of its BOD loads and should try to achieve the nutrient reduction loads simultaneously, pursuant to the Chesapeake Bay Agreement. Where federal facilities have storm water permits and monitoring data, calculations should be based upon real data. For relatively impervious areas such as the Washington Navy Yard, the average annual loading rate computed by the model for BOD was 81.8 pounds per acre, for phosphorus 2.4 pounds per acre and for nitrogen 15.9 pounds per acre. These rates would need to be reduced proportionally. Loading rates for parkland were much less. The TMDL loads for storm water were developed using algorithms based upon pervious and impervious land use.

Other Sources and Reserve

The allocation of BOD to boats, ships, houseboats, and floating residences is zero. The allocation of BOD to reserve is zero.

Summary of Load Allocation

TOTAL ANNUAL LOAD - POUNDS

	BOD	NITROGEN	PHOSPHORUS
MARYLAND	1,036,268	590,859	84,248
DC CSO	152,906	12,171	8,047
DC SW	132,807	44,515	7,338
TOTAL	1,339,205	647,545	99,633

The distribution of the pollution loads by jurisdiction under this allocation is roughly equivalent to the land area. The District occupies about 17% of the land and is allocated 22% of the BOD load, 10% of the nitrogen load, and 16% of the phosphorus load.

Margin of Safety

The final load allocations include a 1% margin of safety from the total load allocations. The one percent for BOD is 13,524, nitrogen is 6,540 and phosphorus it is 1,006. An extra 30% decrease from Maryland is only during the three highest flow events. This extra portion from Maryland equals 17,224 pounds per year for BOD. For BOD, both the margin of safety and the extra portion from Maryland is subtracted from 1,058,000 pounds per year.

Additional Considerations

The nutrient reduction loads are not a part of this TMDL at this time. Further refinements need to be made to TAM/WASP and the issue revisited following improvements to the eutrophication calculations. Additionally, the CSO loads in the model were divided with about 45 percent entering into Segment 9 from the Northeast Boundary Sewer and about 45% entering into Segment 13 from the pump stations. It appears that the water quality would benefit from the shifting of CSO loads from segment 9 to segment 13 and that a larger allowable load could be accommodated. The treatment efficiency of the swirl concentrator, the cleaning of the interceptor between the Northeast Boundary Sewer and the pump station, and the capacity of the pump station, all affect the ability to shift the loads and will be addressed in the long-term control plan. The long-term control plan will use a version of the same water quality model as was used to develop this TMDL. If a segment by segment adjustment is warranted, then the TMDL will be revised to reflect the adjustment.

REASONABLE ASSURANCE AND CONTINUING EFFORTS

On May 10, 1999, Mayor Williams signed a new Anacostia Watershed Restoration Agreement with Maryland, Prince George’s County, Montgomery County, and U.S. EPA to increase efforts to improve water quality. The Agreement has six major goals. The first one pertains to this TMDL:

> Goal #1: dramatically reduce pollutant loads, such as sediment, toxics, CSOs, other nonpoint inputs and trash, delivered to the tidal river and its tributaries to meet water quality standards and goals.

On June 28, 2000, Mayor Williams, Governor Glendening, U.S. EPA and others signed the new Chesapeake Bay Agreement which states:

> By 2010, the District of Columbia, working with its watershed partners, will reduce pollution loads to the Anacostia River in order to eliminate public health concerns and achieve the living resources, water quality, and habitat goals of this and past agreements.

Thus, an agreement is in place which clearly demonstrates a commitment to the restoration of the river by the year 2010. This establishes a completion date for implementation of those activities necessary to achieve the load reductions allocated in this TMDL.

The Comprehensive Pollution Abatement Plan for the Anacostia River has three primary components:

1. The Nine Minimum Control Plan and Long Term Control Plan from DC Water and Sewer Authority (DC WASA) will renovate the CSO system limiting the overflows to 430 lb./day.
2. The State of Maryland reducing the BOD load by 2839 lb./day, in MDE’s TMDL which correlates with 40% reduction agreed to in the Chesapeake Bay Agreement. This Agreement was renewed in June, 2000. A copy is attached as Appendix 2.
3. The development and implementation of storm water BMPs.

Source Control Plan

Upstream Target Load Reductions for Maryland

Based upon the best available information, load reductions for BOD, nitrogen and phosphorous were selected to achieve Maryland and DC WQS for DO at the DC/MD line. Maryland has committed to a 40% nitrogen and phosphorus reduction in the Bay Agreement and has developed tributary strategies that will achieve that reduction in the Anacostia basin. DC estimates that the controls needed to achieve the nutrient reductions will concomitantly achieve at least a 50% reduction of the BOD loads. During high flow events, tighter controls will be needed and therefore has been added into the load table**.** It is recognized that Maryland is in the process of refining the load estimates.

The implementation of the BOD control measure is for the daily average D.O. concentration. The diurnal fluctuation of D.O. in the Anacostia River is due to algal populations and is dealt with in the voluntary Chesapeake Bay Agreement. The Total Suspended Solids TMDL model for the Anacostia River contains a new light formula, which will convert 24 hour averages to night and dark periods. This will allow for a more detailed examination of the Chesapeake Bay Program efforts.

CSO Load Reductions

WASA is currently engaged in the following CSO reduction programs.

1. Nine Minimum Controls Plan.
2. Development of the Long-Term Control plan for CSOs scheduled to be complete by July, 2001. The completion of the LTCP is contingent upon approval from U.S. EPA and DC DOH.
3. East side interceptor cleaning to remove sedimentation and restore transmission capacity.
4. Pump station rehabilitation to increase transmission capacity to the treatment plant.
5. Inflatable dam rehabilitation to restore the dam’s ability to hold sewage inside the pipe, hence reduce overflows.
6. Swirl concentrator rehabilitation and performance enhancements to improve treatment.

There is a significant contribution from federal lands in the combined sewershed to the CSO load to the Anacostia. It is anticipated that the long-term control plan will address that problem.

Storm Water Load Reductions

The DC Department of Health issued the Nonpoint Source Management Plan II in June, 2000. The plan contains descriptions of the current programs and activities that are performed by DC Government to reduce nonpoint source pollution.

Under the U.S. EPA issued Municipal Separate Storm Sewer Permit there are a number of requirements. The most pertinent of these is the requirement to develop a storm water management plan by April, 2002. The plan should provide additional mechanisms for achieving the load reductions needed.

Major currently operating programs in DC which reduce loads are as follows:

1. Street sweeping and catch basin cleaning.

2. Requirements for storm water treatment on all new development and earth disturbing activities such as road reconstruction.
3. Regulatory programs restricting illegal discharges to storm sewers.
4. Demonstration BMPs, stream bank stabilization, and wetlands construction.
5. Environmental education and citizen outreach programs to reduce pollution causing activities.

Federal lands encompass approximately 18 percent of the land inside DC that contribute flow to storm water to the Anacostia River. Consequently, load reductions are assigned to the federal government to achieve. The Washington Navy Yard, GSA-Southeast Federal Center, and Anacostia Naval Air Station have or will have storm water permits issued by U.S. EPA and certified by DC DOH. Under these permits, the federal facilities are required to have storm water management plans to control storm water runoff. The remaining federal facilities such as the National Park Service and National Arboretum will need to develop storm water management plans to reduce their loads and implement those plans.

The District of Columbia Water Pollution Control Act (DC Law 5-188) authorizes the establishment of the District's Water Quality Standards (21 DCMR, Chapter 10) and the control of sources of pollution such as storm water management (21 DCMR, Chapter 5). The storm water management regulations require the hydraulic control of the once in 15 years storm and the water quality treatment of the first one half inch of rainfall.

The implementation of BMPs to achieve the reduction of pollutants should use a design storm that results in pollution reduction of the first one half inch of runoff.

Future Activities

This TMDL is based upon the best information that was available. It is known that a large number of activities are currently underway which will improve the understanding of the sources of pollution to the river and the effects on the river.

The DC Water And Sewer Authority is currently engaged in developing the CSO Long-term Control Plan. This plan will increase the accuracy of information concerning when and where CSOs overflow, and how long and how much is discharged, thus improving the accuracy of the CSO load rates. Instream wet weather surveys and some storm sewer data will be compiled as part of the plan development which can be used to improve the accuracy of these loads. A dye study of the tidal Anacostia River was conducted during the summer of 2000 and will be used to improve the hydrodynamic calculations of the TAM/WASP model. A sediment flux study has been conducted by WASA but was completed too late to be used to calibrate the model but may be useful in refining the model in the future. An additional real time dissolved oxygen monitor was placed at the DC/MD line and the data was not available in time for this TMDL.

The State of Maryland is working to produce a computer model of the watershed. This model will provide a more accurate estimation of their non-tidal loads and available control options. ICPRB is refining the light availability algorithm and that will improve the eutrophication aspects of the computation. Extending the model simulation period up to present time will increase the accuracy of the load reduction calculation. Finally, determining the Federal contribution of pollution to the CSO loads will be completed in the next year.

The Anacostia River has been allocated a Zero Discharge from watercraft in this document. In the Chesapeake Bay 2000 agreement which was signed by the signatory states, The District of Columbia, US EPA, has a provision that by 2003 there will be no discharge of human waste from any boats. This is still the District of Columbia's plan. DOH has funded pump out stations at every marina in the Anacostia River.

With the availability of improved information the TMDL should be revised in the next year.

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APPENDICES

I. Calculations of existing loads used in developing the TMDL.
II. Chesapeake Bay 2000 Agreement.
III. District of Columbia’s Surface Water Quality Standards

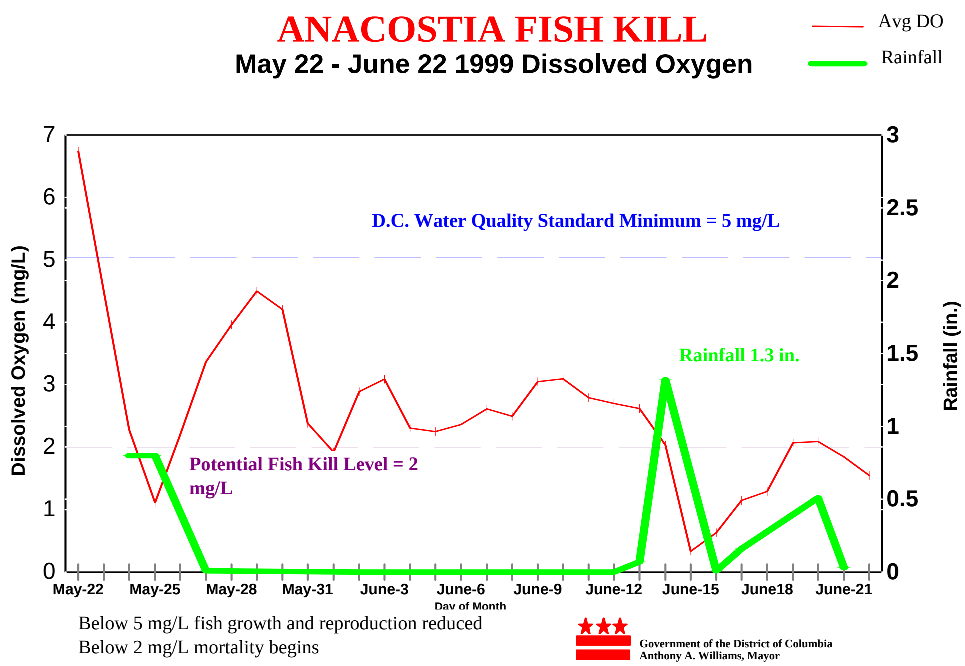

Figure 1: Pennsylvania Avenue Continuous Monitoring Station

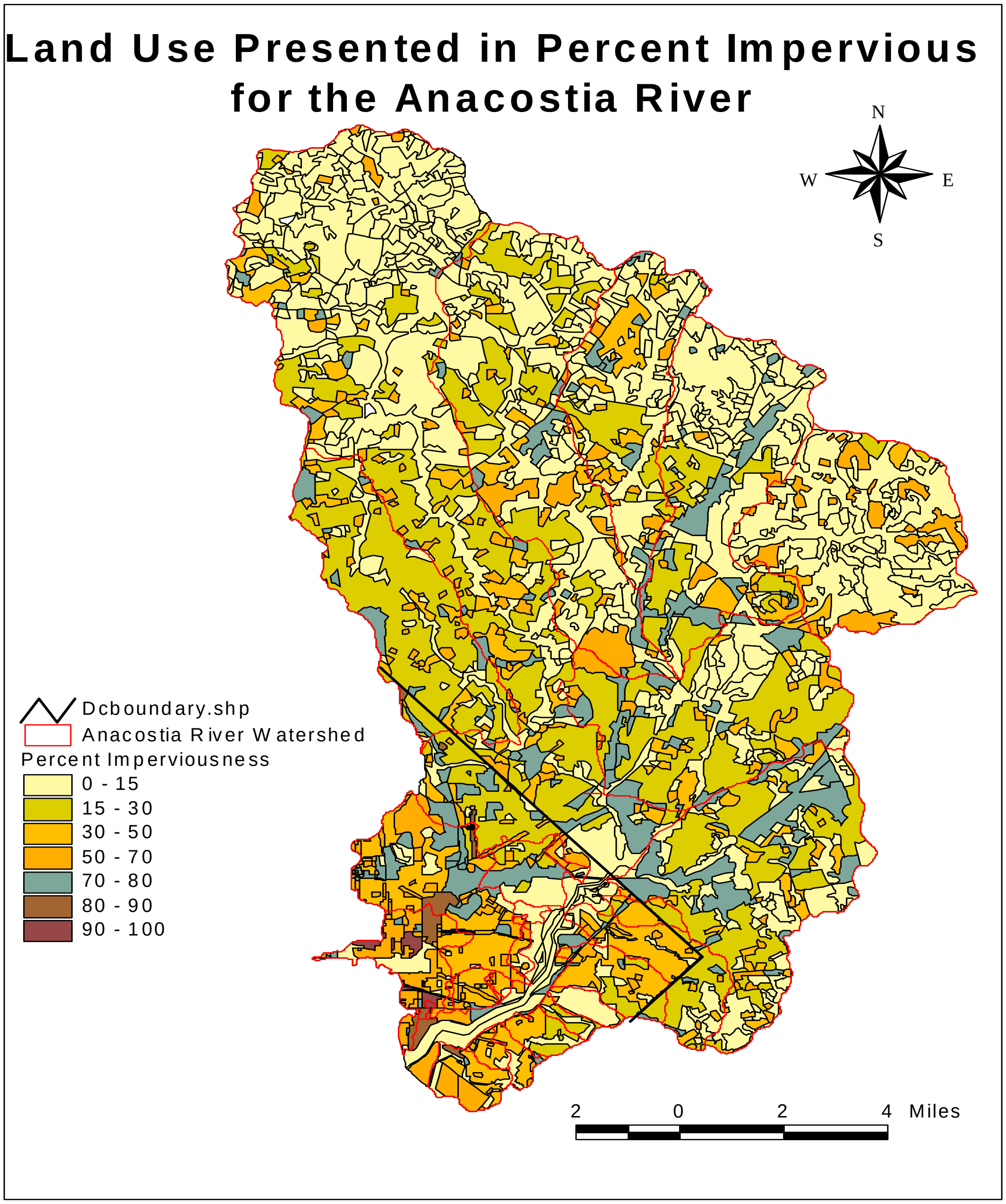

Figure 2 Land Use in the Anacostia Watershed

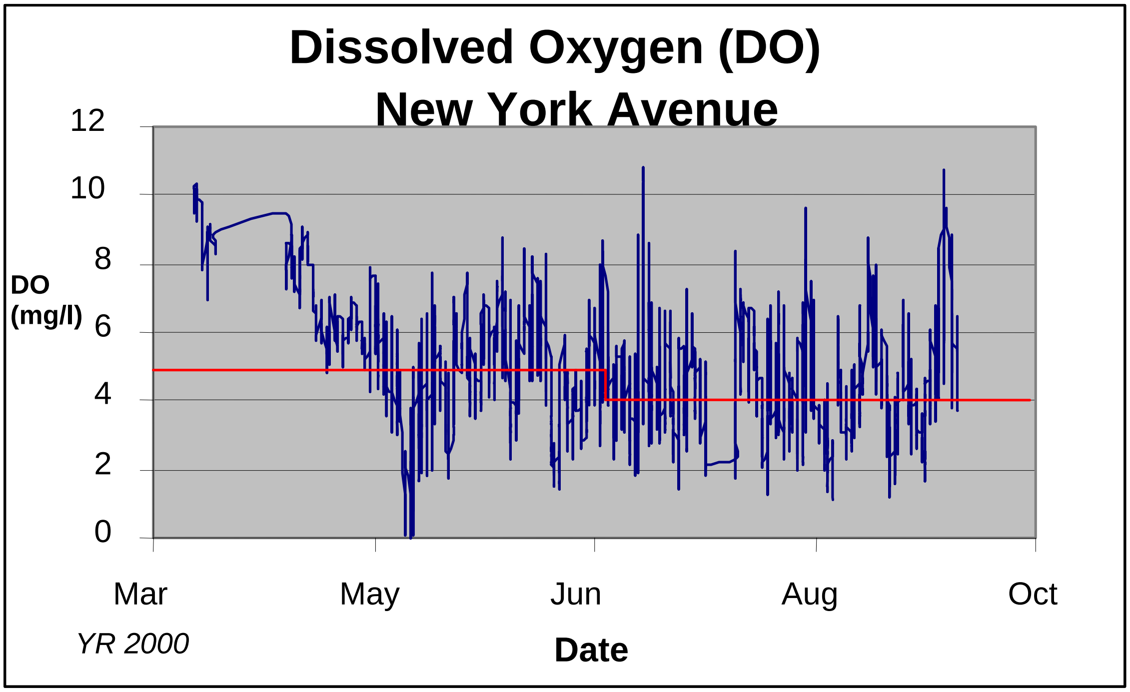

Figure 3: New York Ave Continuous Monitoring Station

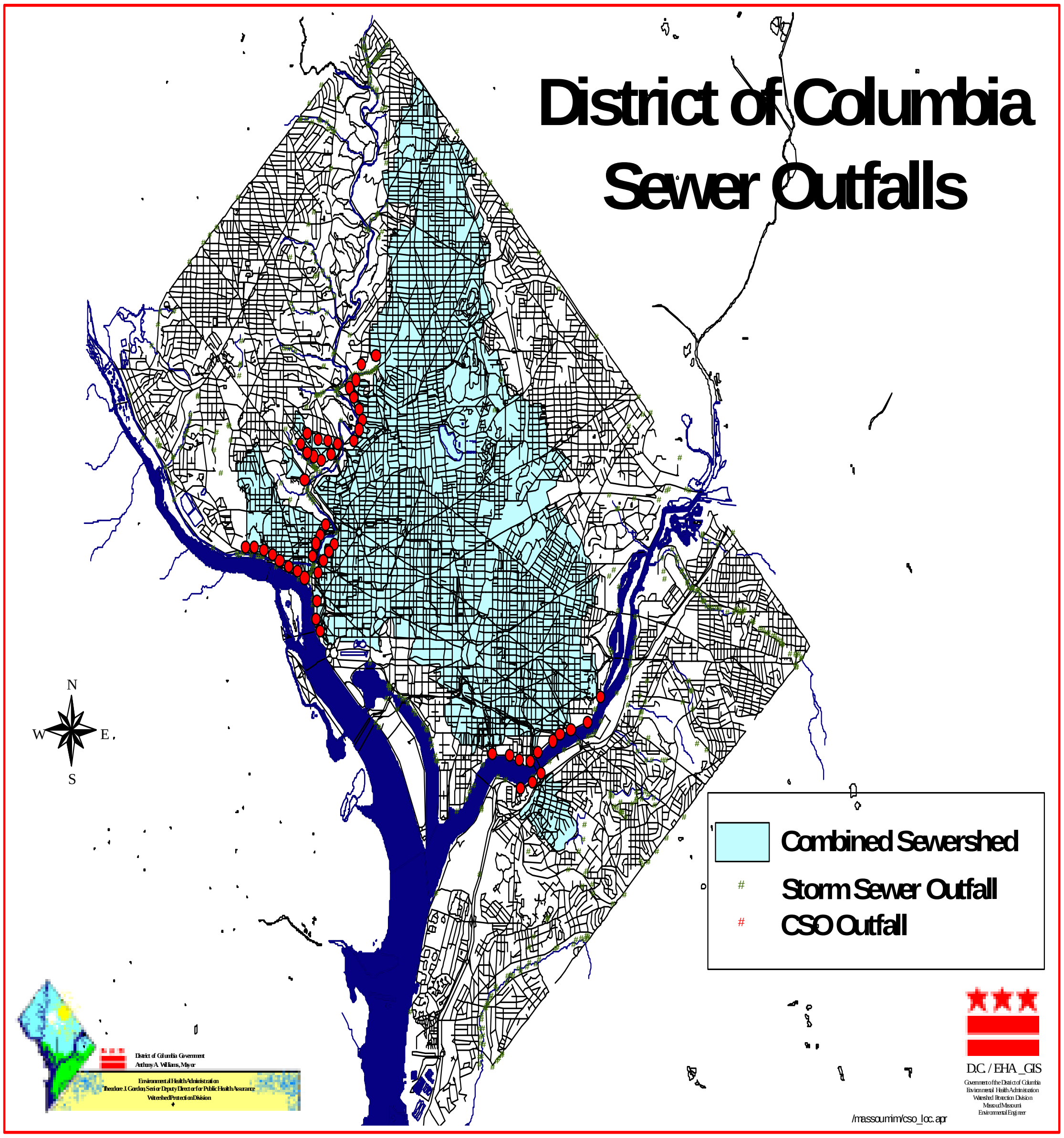

Figure 4: Combined Sewer Map

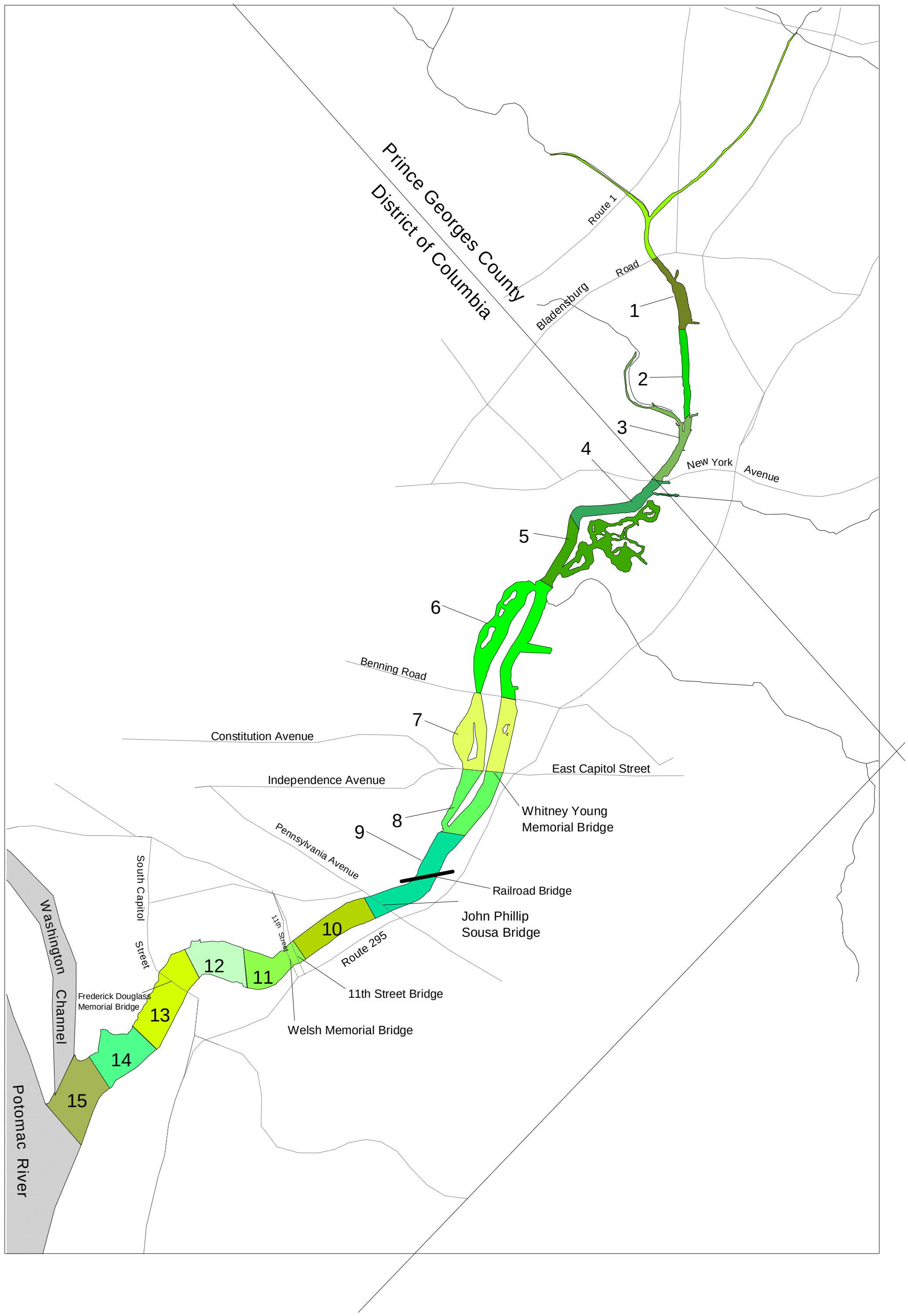

Figure 5 Segments Used in the Anacostia River TAM/WASP Model.

Dissolved Oxygen at New York Avenue

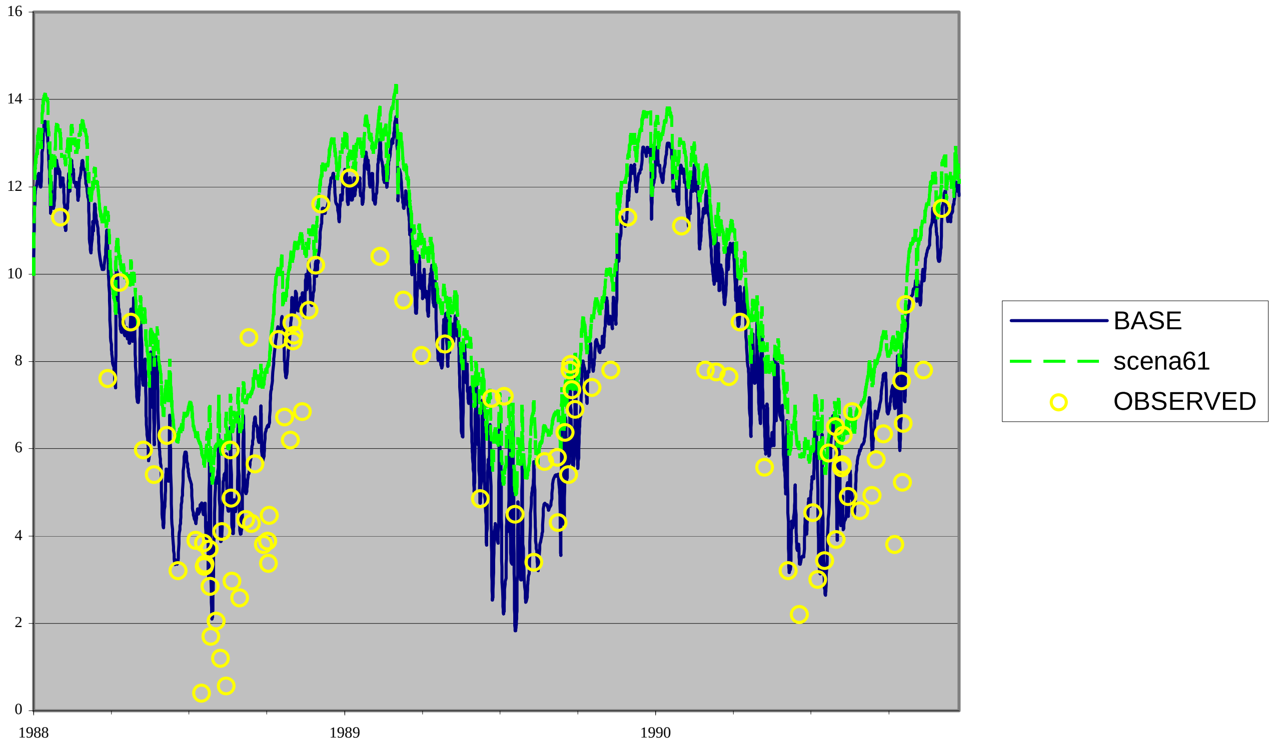

Figure 6a: Dissolved Oxygen in mg/L for three years

Dissolved Oxygen at Benning Road

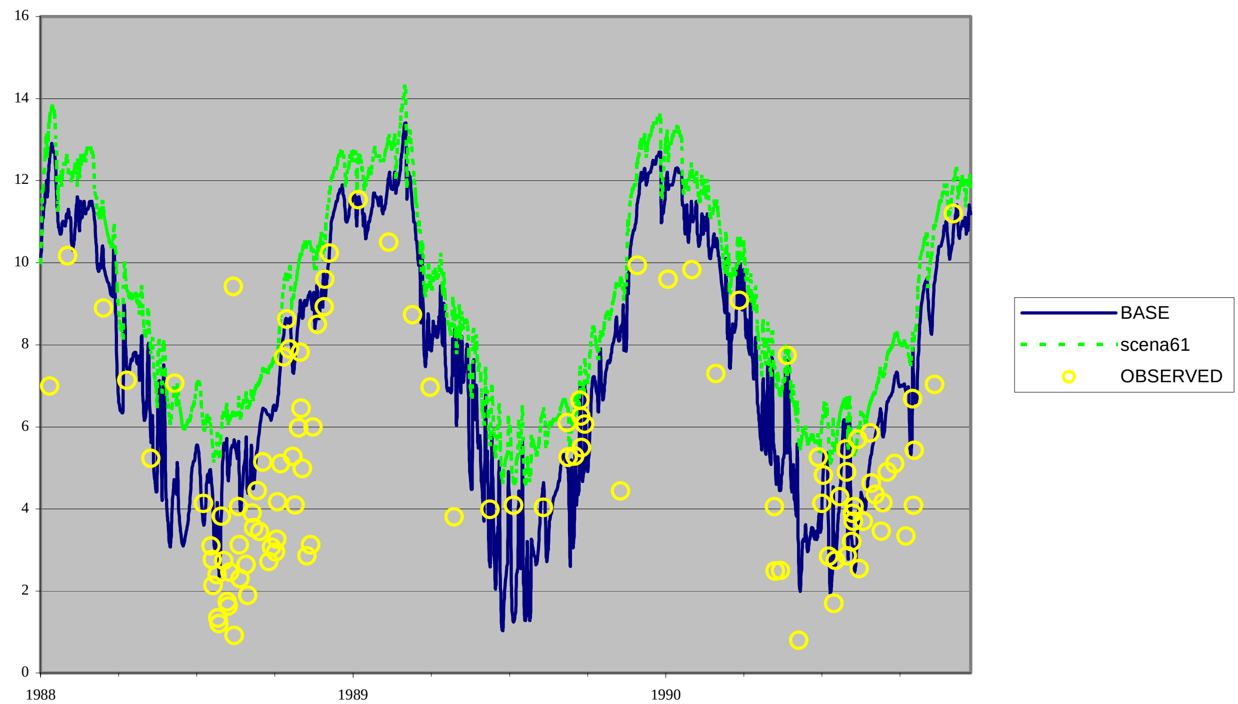

Figure 6b: Dissolved Oxygen in mg/L for three years

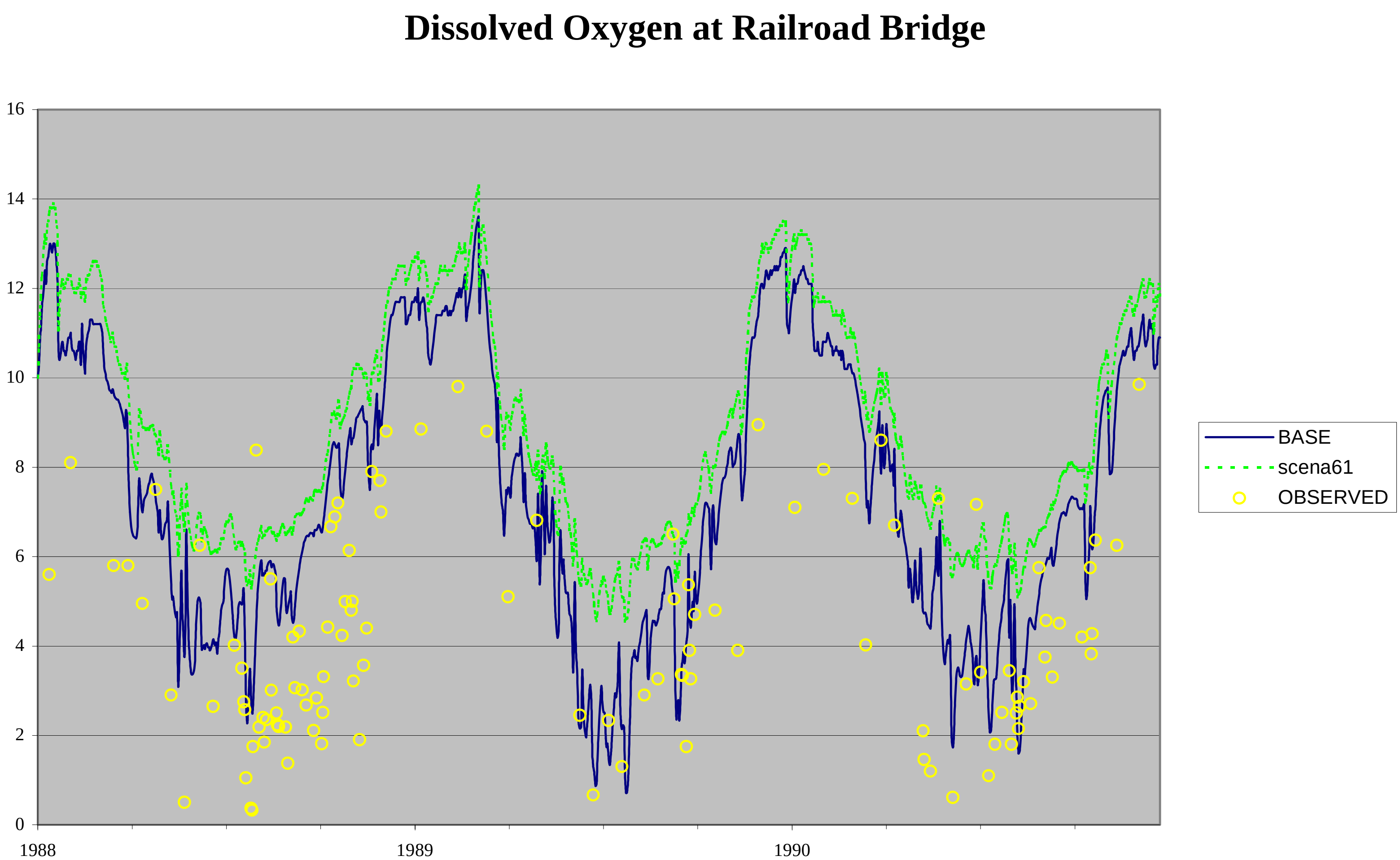

Figure 6c: Dissolved Oxygen in mg/L for three years

Dissolved Oxygen at South Capital Street

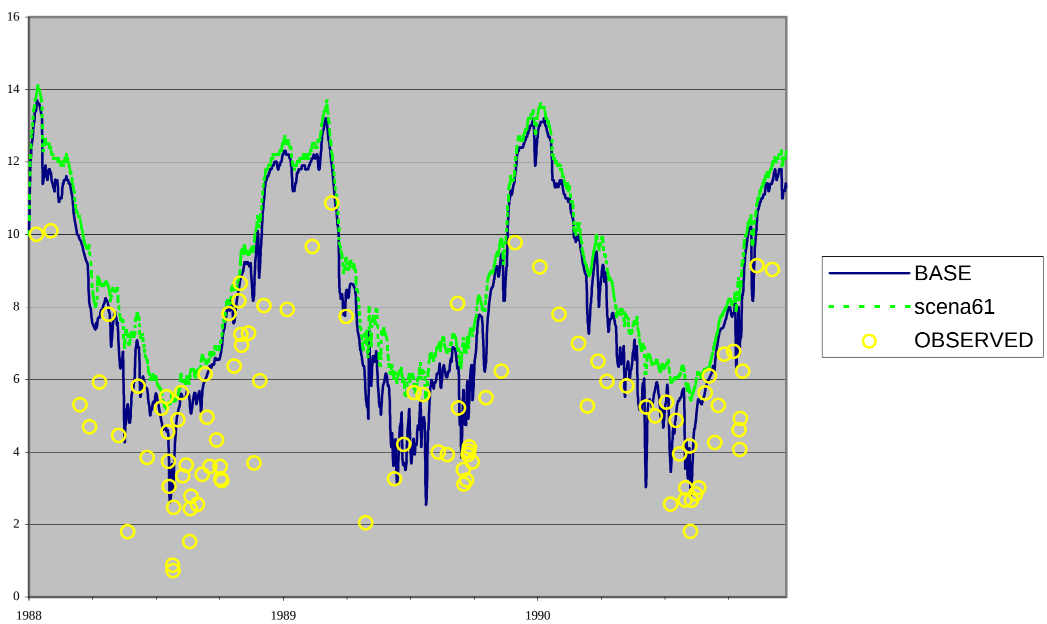

Figure 6d: Dissolved Oxygen in mg/L for three years